unstable symptoms preoperatively. Their medical records were reviewed for fatal and nonfatal adverse events.

Results: Perioperative death occurred in 1 pt (3%) due to cardiogenic shock from acute myocardial infarction (AMI). Perioperative morbidity included:

Cardiac		Non-Cardiac	
Angina	10 (32%)	Renal Failure	2 (6%)
AMI	2 (6%)	CVA	1 (3%)
CHF	8 (26%)	Sepsis	1 (3%)
Arrhythmia	4 (13%)	Transfusion	6 (19%)

Conclusions: Perioperative mortality and noncardiac morbidity in pts with class III or IV angina pectoris undergoing isolated TMR is low. Compared to conventional coronary artery bypass surgery, TMR pts are at higher risk for perioperative cardiac events, likely reflecting the lack of immediate benefit from the procedure in the setting of severe CAD. These pts merit vigilant surveillance for adverse cardiac events and aggressive medical management in the perioperative period.

1119-46 Clinical Experience With Transmyocardial Revascularization Utilizing a Holmium:YAG Laser

K.B. Allen, R.D. Dowling, D.A. Heimansohn, E. Reitsma, L.T. Didelot, C.J. Shaar. *St. Vincent Hospital, Indianapolis, Indiana; University of Louisville, Louisville, Kentucky, USA*

Background: In the United States, studies have been underway since 1995 to assess the safety and efficacy of Transmyocardial revascularization (TMR) using a holmium:YAG laser.

Methods: TMR was performed in 42 patients with refractory angina who were not candidates for PTCA or CABG (mean age 62 ± 11, range 38–79 years). Patients had either Class IV angina (n = 23) or had unstable angina (n = 19) and were unweanable from intravenous nitroglycerin. Preoperative thallium studies identified the extent and location of reversible ischemia. Operative exposure was via a limited left anterior thoracotomy. An average of 45 ± 11 laser channels were created with a mean operative time of 106 ± 38 minutes.

Results: At three months follow-up (n = 23) mean angina class was 1.5 ± 0.1 ($p < 0.001$), and at six months follow-up (n = 11) mean angina class was 1.1 ± 0.1 ($p \leq 0.002$); versus 4.0 ± 0 at baseline. Mortality was 12% (5/42) with no late deaths. Complications included ventricular arrhythmias 12% (5/42), intraaortic balloon placement 12% (5/42), reoperation for chest wall hemorrhage 2% (1/42), and respiratory failure requiring reintubation 2% (1/42). Median postoperative length of stay was 5.5 ± 4.9 (range 1–25) days.

Conclusion: Transmyocardial revascularization with a Ho:YAG laser results in a significant reduction in angina class and is beneficial in patients with refractory angina untreatable by conventional methods.

1120 Long-Term Outcome of Congenital Heart Disease: Adult With Congenital Heart Disease

Tuesday, March 31, 1998, Noon–2:00 p.m.
Georgia World Congress Center, West Exhibit Hall Level
Presentation Hour: Noon–1:00 p.m.

1120-154 Outcome in Patients With Clinically Silent Coronary Artery Fistulae

M.C. Sherwood, S. Rockenmacher, S.D. Colan, T. Geva. *Children's Hospital, Boston, Massachusetts, Lahey Hitchcock Clinic, Manchester, New Hampshire, USA*

Background: With the advent of high resolution 2-D and color echo the detection rate of clinically silent coronary artery fistulae (CAF) has increased. Because the clinical significance and outcome of these CAF has not been defined, this study aims to determine the clinical significance of echo diagnosed, clinically silent CAF.

Methods: The echo, clinical, ECG, and angiographic findings and documented follow-up of 31 patients, mean age 7.2 ± 8.4 years (range 0.01–39.9) at presentation, with an unsuspected echo finding of CAF (1986–1997), were analyzed. Sinusoids and small fistulae following intracardiac surgery were excluded.

Results: The indications for echo were known heart disease (n = 2), murmur (n = 23), cardiomegaly (n = 2), chest pain (n = 1), stridor (n = 1), syncope (n = 1) and chest trauma (n = 1). Cardiac anomalies (n = 10) were ASD, VSD, bicuspid aortic valve, mild Ebstein's anomaly, coarctation LV aneurysm, and RA appendage hemangioma. CAF were detected with color Doppler in all patients. The origin was from the left coronary system (n = 27), right coronary system (n = 3) and bilateral (n = 1). The entry sites were the PA (n = 18), RV (n = 8), RA (n = 2) and LV (n = 3). The entire length of CAF was visualized in 14 patients. Angiography (n = 5) confirmed the echo findings (n = 2), and delineated the origin (n = 2) or entry point of CAF (n = 1). Follow-up was to mean age 8.6 ± 8.4 years (range 0.3–42.0). Spontaneous closure of CAF (n = 7) occurred at mean age 6.8 ± 4.3 years (range 0.3–13.7). In 23 patients CAF persisted, without intervention. All patients remained asymptomatic, with no adverse clinical events or ECG evidence of ischemia at mean age at follow-up of 9.3 ± 9.1 years (range 0.3–42.0).

Conclusion: Based on this experience there was no evidence that clinically silent CAF that are diagnosed incidentally by echo are associated with adverse clinical outcomes. Conservative management of these patients appears to be appropriate.

1120-155 Outcomes of Aortic Valve Stenosis Presenting in Neonates

S. Baram, B.W. McCrindle, R.M. Freedom, D. Nykanen. *The Hosp. for Sick Children, Univ. of Toronto, Canada*

Background: Management of isolated aortic valve stenosis (AVS) requiring intervention at age <3 mo is controversial. We sought to define factors associated with outcomes after neonatal presentation.

Methods: From 1/85 to 12/96, 62 infants presented with AVS at <3 mo of age; 7 were excluded due to significant mitral valve abnormalities (4 died). Clinical, echo, hemodynamic and angiographic, management and outcome data were obtained.

Results: Median age at presentation was 6d, with only murmur in 30, signs of CHF in 20 and poor perfusion/shock in 5 pts. Initial echo showed reduced LV function in 26%, with a mean peak instantaneous gradient of 69 ± 30 mmHg in those with normal function. There were 4 deaths (7%), all with poor function and before age 1.4 mo, with survival thereafter of 92% (95%CI, 85–99.6%) up to age 11.9 yrs. Initial intervention was transcatheter dilation in 23 and surgical valvotomy in 20 pts, with 12 having no intervention to date. Freedom from intervention for AVS was 69% at age 1 wk, 58% at 1 mo, 35% at 3 mo, 29% at 1 yr and 19% at age 5 yr. Additional interventions were required in 14 pts. Patients without poor perfusion/shock, normal LV function and peak instantaneous gradients <60 mmHg at presentation (n = 19, Group I) vs. pts with poor function or initial gradients ≥60 mmHg (n = 36, Group II) had better survival (I-0 vs. II-4 deaths), and longer freedom from intervention at age 1 wk (I-100% vs. II-53%), 1 mo (I-95% vs. II-39%), and 6 mo (I-79% vs. II-12%) ($p = 0.0001$).

Conclusions: The majority of neonates presenting with AVS require intervention, although this may be safely delayed in selected patients with lower initial gradients and good LV function.

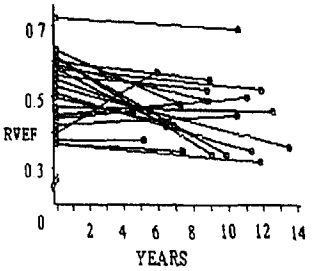
1120-156 Course of Right Ventricular Function in Patients With Pulmonary Insufficiency After Repair of Tetralogy of Fallot

M.S. Schamberger, R.A. Hurwitz. *Indiana University, Indianapolis, IN, USA*

Background: Surgical repair of Tetralogy of Fallot (ToF) frequently results in pulmonary insufficiency (PI). Nevertheless, little information is available on the long term impact of PI on right ventricular function.

Methods: 21 patients with at least moderate PI after repair of ToF were studied serially by radionuclide angiocardiography. The first (baseline) study was obtained a mean of 1.2 years (range 0.1 to 6.4) after surgery. The last study was performed a mean of 10.2 years (range 4.6 to 16.9) after surgery.

Results: The mean RVEF at baseline was 0.52 ± 0.1 (normal: 0.53 ± 0.06; n.s.s). At the time of the last study the mean RVEF had decreased significantly to 0.45 ± 0.1 ($p < 0.01$).



At the last study, 7 patients (33%) had a RVEF <0.42, which is >2 SD below our laboratory normal. Using 0.05 as our reproducibility factor for change in RVEF, 2 patients showed improvement in RVEF, 7 patients showed no change and 12 patients (57%) showed a decrease in RVEF.

Conclusion: In spite of a normal early post operative RVEF, many patients with PI after repair of ToF show a significant decrease in RVEF during long term follow up.

1120-157 The Arterial Switch Operation Twenty Years Later

P.A. Hutter, E.J. Meijboom, F.J. Hitchcock, N. Sreeram. *Dept. of Pediatric Cardiology, Wilhelmina Children's Hospital, Utrecht, the Netherlands*

Background: The aim of our study was to evaluate incidence and severity of long term sequelae after arterial switch operation (ASO) for transposition of the great arteries (TGA).

Methods: We studied 99 consecutive pts who survived the ASO between 1977 and 1996. 65 pts had simple TGA, 34 pts had associated VSD and 11 had coarctation. A standard study protocol including serial ECG, echocardiography, and Holter was performed. Catheterisation or MRI were performed when indicated.

Results: 95 pts are in NYHA class 1, needing no medication. 1 pt died 14 years after ASO from pulmonary hypertension. 3 pts survived perioperative myocardial infarctions (MI); all had left coronary artery occlusion. All 3 have impaired LV function, but only 1 has symptoms and has had implantation of a defibrillator. Two pts have symptoms from aortic insufficiency. 38 reinterventions were performed in 24 pts, 33 for pulmonary stenosis, 2 for aortic stenosis, 2 for recoarctation and 1 for aortic insufficiency. Mea.. freedom from reintervention was 14 years (95% CI 12.3–15.6 y). 24 reinterventions were surgical, and 14 were balloon dilations. Pulmonary stenosis was the most frequent complication, present in 23% of patients. LV. dysfunction was seen in 7 pts and dysrhythmia in 10 pts, of whom 8 have no symptoms. Apart from the three pts with MI, no coronary obstruction was found in 40 pts who had angiography.

Conclusion: At follow-up after ASO, the overwhelming majority of pts are in NYHA class 1. Pulmonary stenosis remains the most important late complication, and is only partially avoidable with improved surgical technique.

1120-158 Ten-Year Follow-up of Adults With Repaired Tetralogy of Fallot Using Serial Radionuclide Angiography

J.T. Elliott, V. Guru, M.A. Gatzoulis, D. Harrison, E. Oechslin, S. Siu, G. Webb, W.G. Williams, P. Liu, P. McLaughlin. *The Toronto Hospital, Toronto, ON, Canada*

Background: Right ventricular dysfunction contributes to long-term outcome in pts with repaired tetralogy of Fallot (rTOF). We employed serial radionuclide angiograms (RNA) to examine changes in right (RV) and left ventricular (LV) function in adults with rTOF.

Methods: We reviewed 10-yr records (1987–1997) of 97 pts (55 men) followed in our clinic with rTOF (mean age at repair 12.9 ± 10.6 yrs, mean age at follow-up 37.6 ± 9.9 yrs) and at least 2 RNAs.

Results: At the study conclusion most remained well (NYHA class I-80%, II-15%, III-5%). 11 had clinical arrhythmias (7 atrial, 4 VT); 1 died suddenly. 13 had elective right ventricular outflow tract (RVOT) reoperation (pulmonary valve replacement-10, relief of RVOT obstruction-3). No change in RV and LV function was seen (mean interval 5.7 ± 2.1 yrs between RNAs).

	LVEF rest	LVEF exercise	RVEF rest	RVEF exercise
First RNA	54.0 ± 12.1	59.2 ± 12.8	37.7 ± 11.8	40.1 ± 13.3
Last RNA	55.5 ± 12.4	60.8 ± 13.6	39.9 ± 10.8	42.9 ± 12.6

Mean values ± SD, first vs. last not significant.

In the reoperation group preoperative RV function did not differ from the remainder and did not change after surgery.

Conclusion: This group of closely followed rTOF pts remained well over 10 yrs with a low incidence of arrhythmias and stable RV and LV function, despite a relatively large number of reoperations. Aggressive intervention for right-sided hemodynamic abnormalities may have contributed to this outcome. Preserved ventricular function may herald a favorable long-term outlook in this group.

1120-159 Balloon Angioplasty of Native Coarctation of the Aorta in Adolescents and Adults: Longterm Results

J.K. Michaelsen[1], R. Schräder[2]. [1]*University Hospitals Frankfurt/M and Heidelberg, Germany;* [2]*Cardioangiologisches Centrum Bethanien Frankfurt/M, Germany*

Background: In patients with coarctation of the aorta (CoA) arterial hypertension frequently persists when surgical repair is performed beyond age 20 years. We studied the effects of balloon angioplasty on blood pressure up to 12.5 years after the procedure.

Methods: 21 patients 24–50 years old (average, 32.6) underwent clinical follow-up 3.5–12.5 years after ballon angioplasty, including MRI, 24-hour ambulatory blood pressure measurement and non-invasive gradient measurement. Before ballon angioplasty 18/21 patients had hypertension. The pressure gradient was 59.7 ± 11.4 mmHg and the diameter of the stenotic segment 5.3 ± 1.9 mm Directly after angioplasty the pressure gradient decreased to 20 ± 10.2 mmHg and the diameter increased to 11.6 ± 2.7 mm.

Results: At latest follow-up the gradient (Doppler) was 9.7 ± 7 mmHg, the diameter 14.6 ± 2.9 mm (MRI), 14/21 patients were normotensive and 7 (33%) had borderline hypertension. The residual pressure gradient of these 7 hypertensive patients was 13 ± 7 mmHg compared to 7 ± 6 mmHg in the normotensive patients. In all patients the former coarcation site was clearly visualized and measurable by MRI.

Conclusion: Balloon angioplasty is an effective mode of treatment in selected adolescent and adult patients with discrete native coarcation. At average follow-up interval of 7.9 years 66% were normotensive. Patients with persistent hypertension had higher residual pressure gradients. MRI is very useful and reliable in imaging coarctation of the aorta.

1120-160 Mechano-electric Feedback Late After the Mustard Procedure for Transposition of Great Arteries: The Arrhythmogenic Substrate?

M.A. Gatzoulis, J. Walters, P.R. McLaughlin, G.D. Webb, P. Liu. *The Toronto Hospital, Toronto, ON, Canada*

Background: The pathogenic mechanism for late atrial arrhythmias and sudden death (SD) after the Mustard procedure for transposition of great arteries (TGA) remains unknown. We employed different imaging techniques to examine the possible effects of ventricular dysfunction on arrhythmogenesis in these patients.

Methods: We studied 23 unselected patients (mean age 27.4 ± 4 yrs) at a mean of 24.7 ± 4yrs after the Mustard procedure with a 12-lead ECG, CXR, Echo, exercise-RNA and MRI. ECG and ventricular function indices were analyzed prior to the onset of clinical arrhythmia and therapy.

Results: There were no correlations between ventricular function indices assessed by Echo and exercise-RNA. In contrast, there were significant correlations between MRI and ECG parameters of conduction: max QRS duration correlated with RVEDD and RV free wall thickness ($r = 0.72$, $p < 0.001$ and $r = 0.59$, $p < 0.01$ resp.). When the 7 patients with clinical arrhythmia (atrial flutter-6 and VT-1) compared with the remainder, significant differences were found on QRS duration (137 ± 23 vs 116 ± 14 ms, $p < 0.04$), QT interval (522 ± 73 vs 450 ± 37 ms, $p < 0.004$) and QT dispersion (110 ± 54 vs 53 ± 25 ms, $p < 0.003$) and NYHA status.

Conclusion: QRS duration on the ECG in adult Mustard patients relates to RV volume and possibly pressure load, suggesting the presence of a mechano-electric interaction. Late atrial flutter after the Mustard procedure for TGA may be a surrogate marker for ventricular dysfunction.

1121 Ventricular Function: Congestive Heart Failure

Tuesday, March 31, 1998, Noon–2:00 p.m.
Georgia World Congress Center, West Exhibit Hall Level
Presentation Hour: 1:00 p.m.–2:00 p.m.

1121-29 Chronic Treatment With Amlodipine, but Not Nifedipine, Improves Enhanced Vascular Contractility in Cardiomyopatic Hamsters; A Possible Explanation for the Results of PRAISE Study?

A. Sato, H. Tomioka, S. Watanabe, H. Okamoto, M. Fukao, I. Sakuma, Y. Hattori, M. Kanno, A. Kitabatake. *Hokkaido University School of Medicine, Sapporo, Japan*

Background: The PRAISE study demonstrated that amlodipine, a new dihydropiridine Ca^{2+} channel antagonist, improves the prognosis of heart failure caused by nonischemic cardiomyopathy. However, the precise mechanisms by which amlodipine improves the prognosis have not been elucidated. We had previously reported that the contractility of aortic smooth muscle in cardiomyopathic hamsters (BIO 53.58: BIO) was markedly enhanced compared with that in normal hamsters (Flb), and the enhanced contractility may contribute to the pathogenesis in heart failure. In this study, we examined the effects of chronic treatment with amlodipine and nifedipine on vascular contractility in BIO.